

CLAIMS

1. A method for measuring the depth of a shaft comprising the steps of:
 - a) driving a cone containing a transducer into soil near the shaft;
 - b) periodically while driving the cone, striking the shaft to generate waves such that the waves propagate down the shaft and through the soil;
 - 5 c) detecting the waves in the soil with the transducer;
 - d) measuring the time between striking the shaft and detecting the waves;
 - e) computing the depth of the end of the shaft based upon the measured times.
2. The method of claim 1 wherein step b) generates at least one of the following type of wave: compressional, shear, flexural.
3. The method of claim 1 wherein the transducer is a hydrophone within a casing filled with water and wherein step a) includes the following sub-steps:
 - a1) pausing the driving while step b) is performed;
 - 5 a2) withdrawing the tip of the cone from around the casing prior to performing step b); and
 - a3) replacing the tip around the casing after performing step b).
4. The method of claim 1 wherein the transducer is a geophone.

5. The method of claim 4 wherein step a) includes the sub-step of pausing the driving while step b) is performed.
6. The method of claim 1 wherein the transducer is a accelerometer.
7. The method of claim 6 wherein step a) includes the sub-step of pausing the driving while step b) is performed.
8. The method of claim 1 wherein the depth of the shaft is determined in step d) by examining a plot of time (between striking the shaft and detecting the waves) versus depth (of the cone) and noting where the plot changes slope.

9. Apparatus for measuring the depth of a shaft comprising:

a transducer of the type which detects waves in soil;

a cone housing the transducer;

an element for driving the cone containing the transducer into soil near the
5 shaft;

an impactor for periodically striking the shaft as the cone reaches a plurality
of depths to generate waves, such that the waves propagate down the shaft
and through the soil to the transducer;

electronics connected to the transducer for providing a signal based upon
10 the detected waves; and

a processor in communication with the electronics for measuring the times
between the impactor strikes and wave detection, the processor calculating
the depth of the shaft based upon the measured times.

10. The apparatus of claim 9 wherein the transducer detects at least one
of the following type of wave: compressional, shear, flexural.

11. The method of claim 1 wherein the transducer is a hydrophone within a
casing filled with water and wherein the cone includes a mechanism for
withdrawing the tip of the cone from around the casing prior to the
periodic impactor strikes and for replacing the tip around the casing
5 after the impact strikes.

12. The apparatus of claim 9 wherein the transducer is a geophone.

13. The apparatus of claim 9 wherein the transducer is a accelerometer.

14. Apparatus for measuring the depth of a shaft comprising:

a transducer for detecting waves;

means for driving the transducer into soil near the shaft;

means for striking the shaft periodically while driving the transducer to

5 generate waves such that the waves propagate down the shaft and through
the soil to the transducer;

means for measuring the time between the periodic striking of the shaft and
subsequent detecting of the waves;

means for computing the depth of the end of the shaft based upon the

10 measured times.